Sustainable In-Space Manufacturing through Rapid Prototyping Technology

Completed Technology Project (2013 - 2017)

Project Introduction

In space manufacturing is crucial to humanity's continued exploration and habitation of space. While new spacecraft and propulsion technologies promise higher payload capacities and fuel efficiencies, the underlying problem lies in the massive energies required to move a large amount of mass into space. This proposal focuses on rapid prototyping, or additive manufacturing. Additive manufacturing stands out as a viable first attempt at in-space manufacturing, with plastic based processes such as the Fused Deposition Modeling Process (FDM) already tested in microgravity1 and demonstrated suitable for part construction by previous work. Unlike more conventional subtractive fabrication processes, rapid prototyping processes utilize an additive method in which parts are built layer by layer, meaning that only the source material needed for the part is used. Furthermore, the additive process means that one machine can produce any part that fits within its accuracy and build volume limitation. This one machine to multiple parts approach makes rapid prototyping appealing in increasing automation and reliability while reducing excess mass from multiple fixtures and machining tools required by other processes. We hypothesize that effective in-space additive manufacturing processes can be developed by deploying existing plastic based technology in conjunction with recycling capabilities as well as computer controlled melting of Lunar regolith. This research plan is divided into two prongs: the examination of effective on-orbit and on-moon recycling methods for ABS plastic and the development of efficient methods for precisely melting and depositing lunar soil.

Anticipated Benefits

This one machine to multiple parts approach makes rapid prototyping appealing in increasing automation and reliability while reducing excess mass from multiple fixtures and machining tools required by other processes. We hypothesize that effective in-space additive manufacturing processes can be developed by deploying existing plastic based technology in conjunction with recycling capabilities as well as computer controlled melting of Lunar regolith.

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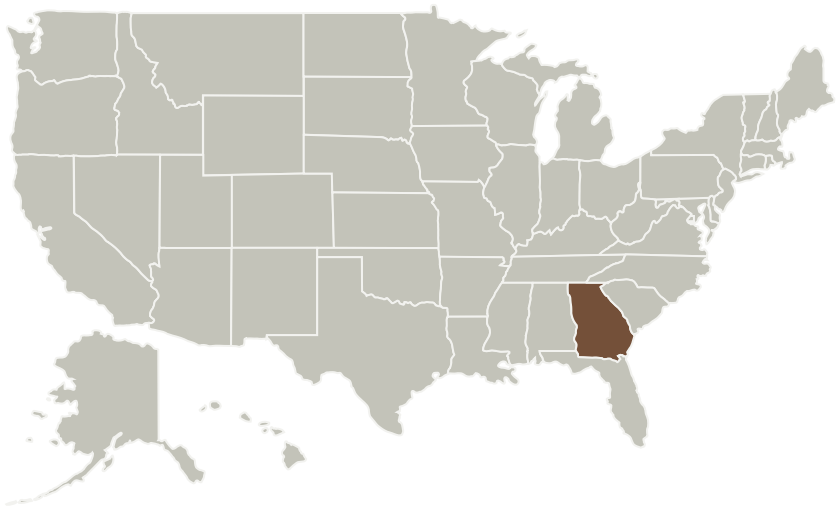
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Georgia Institute of Technology-Main Campus(GA Tech)	Lead Organization	Academia	Atlanta, Georgia

Primary U.S. Work Locations
Georgia

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Georgia Institute of Technology-Main Campus (GA Tech)

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Robert D Braun

Co-Investigator:

Hisham K Ali

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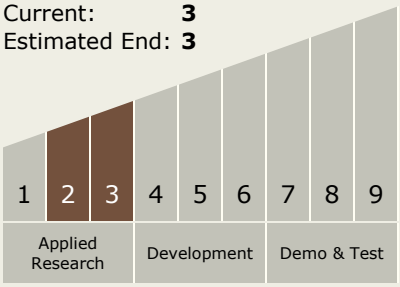
Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.1 Manufacturing Processes

Target Destination

The Moon